

should be mercury thermometers with engraved stems. The total graduations of the thermometers should be from 20 to 120 deg. fahr., in one degree graduations. No ten degrees should occupy a space of less than one-half inch. The accuracy throughout the whole scale must be within one-half degree. The operator should take hold of the top and no part of the body, including the hand, should be nearer than 10 in. to the bulb. The thermometer should not be closer than 5 ft. to any door, window, or other opening; should not be closer than 12 in. to any wall, and should be between 3 and 5 ft. from the floor. A sling instrument should be used for extreme accuracy.

For measuring duct temperatures an angle-duct thermometer should be used, having a flange to bolt on the side of the duct, with the bulb extending into the duct at least 6 in.

Recording thermometers, generally have considerable lag and should not be used for the taking of temperatures for testing, but rather for giving continuous records of the operation of the plant, as the charts will indicate any lack of attention on the part of those responsible for the operation of the plant.

Humidity

The sling psychrometer is the recognized standard instrument for determining humidities. In order to obtain accurate readings considerable skill is required on the part of the operator. The wicking must be clean, distilled water should be used, and the temperature of the water should be slightly above the wet-bulb temperature of the surrounding air.

The psychrometer should be swung rapidly and two or three observations should be made to see that the wet-bulb temperature has become stationary before the final reading is noted. Standard psychrometric tables should be used.

In taking humidity readings in ducts it is usually impracticable to use a sling psychrometer. For this work the stationary hygrodeik arranged for bolting on to the side of the duct, with two bulbs extending into the duct, will be found very convenient. Due to the velocity of the air passing over the bulbs within the duct an accurate reading will be secured, corresponding to that given by the sling psychrometer.

CO₂ Determinations

At ordinary concentrations carbon dioxide is not harmful. The amount of carbon dioxide in the air is a convenient index of the rate of air supply, and of the distribution of the air within large rooms. A high carbon dioxide concentration in parts of an occupied room may indicate air stagnation which can result in objectionable odors or in failure to remove local surplus heat.

The Petterson-Palmquist apparatus has been generally accepted as the standard device for the determination of carbon dioxide in air investigations. The principle involved is the measurement of a given volume of air, the absorption of the contained carbon dioxide in a caustic potash solution, and the remeasurement of the volume of air at the original pressure in a finely graduated capillary tube, the difference in volume representing the absorbed carbon dioxide. (See Report of Committee on Standard Methods for Examination of Air, *American Public Health Asso-*

ciation, Vol. 7, No. 1; *American Journal of Public Health*, Jan., 1917).

Where field conditions are such that this apparatus may not be conveniently used, as in street cars, air samples may be collected in prepared bottles having rubber stoppers, and these may be subjected to laboratory analysis.

Dust

Atmospheric dust is of great importance in certain industrial processes, and if the dust be siliceous in nature, as from grinding stones, the hazard to health may be very serious.

The Hill Dust Counter is a simple device with which to measure the number of very large particles of dust in the air, while more exact studies of dust may be made with the Konimeter, or with the Impinger. (See *Public Health Bulletin*, No. 144, 1925, U. S. Public Health Service).

Bacteria

The number of bacteria which are attached to heavy particles of dust or drops of moisture may be determined by the number of colonies that develop on a culture plate which has been exposed for two minutes. A standard 4-in. Petrie dish, with agar-agar for a media, is used for this purpose. The plates are incubated from 24 to 48 hours at a temperature of 98 deg. fahr. At the end of this time the separate colonies have developed to a size which are easily counted. If an incubator is not available cultures may be grown at room temperatures (70 deg.) for a period of five days.

Volumetric air measurements must be made with skill and precision and great care must be exercised in securing the right conditions under which such measurements are made. There are two general methods in use for measuring air volumes, the first, by means of an anemometer, and the second, by means of a Pitot tube.

Anemometers

The anemometer, as at present obtainable, is not an authoritative instrument for quantitative measurement of air volume through a register or a duct, however useful and acceptable one may be for relative adjustment of air speed.

When it is necessary to employ an anemometer for measuring air volume, the instrument must have been recently calibrated, and the greatest care must be exercised in methods of manipulation. The influence of obstructions at the register face, the distance from the register at which the anemometer is held and the great variation in velocities which exists over the area of most air discharge openings all combine to make an exact quantitative measurement of air by an anemometer a difficult matter. (See Report on Measuring Air Velocities with the Anemometer, with discussion, *AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS TRANSACTIONS*, 1913, Vol. 19, pp. 202 to 207).

Pitot Tubes

Measurements of air velocities exceeding 20 ft. per second should be made by means of Pitot tubes. Volumetric determinations from Pitot tube readings must take into account the barometric pressure, tempera-